

CLAIMS

What is Claimed Is:

1. A method of demodulating an ultra-wideband communication signal, the method comprising the steps of:
 - receiving an incoming signal, wherein the incoming signal comprises a plurality of ultra-wideband pulses;
 - approximating the incoming signal;
 - generating a local signal;
 - generating a first output signal and a second output signal;
 - quantizing the first output signal and the second output signal to produce a first quantized signal and a second quantized signal;
 - generating a difference signal for the first quantized signal and the second quantized signal; and
 - providing an error signal based on the difference signal.
2. The method of claim 1, wherein the step of generating a local signal uses a phase-locked loop.
3. The method of claim 2, wherein the phase-locked loop is gated.
4. The method of claim 3, wherein the phase-locked loop is gated by the incoming signal.

5. The method of claim 1, wherein the step of generating a first output signal and a second output signal comprises:

filtering the local signal to produce a first duplicate signal and a second duplicate signal.
6. The method of claim 5, wherein the filtering uses a plurality of low-pass filters.
7. The method of claim 6, wherein a cut-off frequency of the plurality of low-pass filters is approximately equal.
8. The method of claim 7, wherein the cut-off frequency is approximately 3 gigahertz.
9. The method of claim 5, wherein the filtering uses a matched filter.
10. The method of claim 9, wherein the matched filter comprises a band-pass filter.
11. The method of claim 10, wherein a passband of the band-pass filter is approximately 3 gigahertz.

12. The method of claim 11, wherein a center frequency of the passband is approximately 5 gigahertz.

13. The method of claim 10, wherein a transfer function of the bandpass filter approximates a transfer function of an ultra-wideband transmitter transmitting the incoming signal.

14. The method of claim 1, wherein the generating a first output signal and a second output signal comprises:

multiplying a first duplicate signal and the incoming signal to produce a first output signal.

15. The method of claim 14, wherein the step of generating a first output signal and a second output signal comprises:

delaying a phase of a second duplicate signal to produce a delayed phase signal.

16. The method of claim 15, wherein the step of delaying uses a delay circuit from the group consisting of a 90-degree phase delay circuit and a 270-degree phase delay circuit.

17. The method of claim 15, wherein the step of delaying imparts a delay to a rising edge of the incoming signal.

18. The method of claim 17, wherein the step of delaying shapes the incoming signal to approximately a one bit time duration.

19. The method of claim 1, wherein the step of generating a first output signal and a second output signal comprises:

 multiplying a delayed phase signal and the incoming signal to produce a second output signal.

20. The method of claim 1, wherein the step of generating a first output signal and a second output signal comprises:

 filtering the first output signal and the second output signal.

21. The method of claim 1, wherein the step of generating a difference signal comprises:

 multiplying a first quantized signal with the first output signal.

22. The method of claim 1, wherein the step of generating a difference signal comprises:

 multiplying a second quantized signal with the second output signal.

23. The method of claim 1, wherein the step of generating a difference signal comprises:

calculating an algebraic difference between the first quantized signal and the second quantized signal.

24. The method of claim 1, wherein the step of generating a difference signal comprises:

filtering the difference signal.

25. The method of claim 1, wherein the step of quantizing the first output signal and the second output signal uses at least one multi-level quantizer.

26. The method of claim 25, wherein the at least one multi-level quantizer is selected from a group consisting of: a μ -law quantizer, a 4 level quantizer, a 8 level quantizer, and a 16 level quantizer.

27. The method of claim 1, wherein each of the plurality of ultra-wideband pulses has a duration ranging from about 10 picoseconds to about 1 millisecond.

28. The method of claim 1, wherein each of the plurality of ultra-wideband pulses has at least one of a phase and an amplitude that conveys data.

29. An ultra-wideband receiver, comprising:

a receiver structured to receive an incoming signal, wherein the incoming signal comprises a plurality of ultra-wideband pulses;

an approximator structured to approximate the incoming signal;
a local signal generator structured to generate a local signal;
an output signal generator structured to generate a first output signal and a second output signal;
a quantizer structured to quantize the first output signal and the second output signal to produce a first quantized signal and a second quantized signal;
a difference signal generator structured to generate a difference signal for the first quantized signal and the second quantized signal; and
an error provider structured to provide an error signal based on the difference signal filtered.

30. The ultra-wideband receiver of claim 29, wherein the local signal generator uses a phase-locked loop.

31. The ultra-wideband receiver of claim 30, wherein the phase-locked loop is gated.

32. The ultra-wideband receiver of claim 31, wherein the phase-locked loop is gated by the incoming signal.

33. The ultra-wideband receiver of claim 30, wherein the output generator comprises:

a local signal filter that produces a first duplicate signal and a second duplicate signal.

34. The ultra-wideband receiver of claim 33, wherein the local signal filter comprises a plurality of low-pass filters.

35. The ultra-wideband receiver of claim 34, wherein a cut-off frequency of the low-pass filter is approximately equal.

36. The ultra-wideband receiver of claim 35, wherein the cut-off frequency is approximately 3 gigahertz.

37. The ultra-wideband receiver of claim 33, wherein the local signal filter comprises a matched filter.

38. The ultra-wideband receiver of claim 37, wherein the matched filter comprises a band-pass filter.

39. The ultra-wideband receiver of claim 38, wherein a passband of the band-pass filter is approximately 3 gigahertz.

40. The ultra-wideband receiver of claim 39, wherein a center frequency of the passband is approximately 5 gigahertz.

41. The ultra-wideband receiver of claim 38, wherein a transfer function of the bandpass filter approximates a transfer function of an ultra-wideband transmitter transmitting the incoming signal.

42. The ultra-wideband receiver of claim 29, wherein the output generator comprises:

a first multiplier that multiplies the first duplicate signal and the incoming signal to produce a first output signal.

43. The ultra-wideband receiver of claim 29, wherein the output signal generator comprises:

a phase delayer that delays a phase of the second duplicate signal to produce a delayed phase signal.

44. The ultra-wideband receiver of claim 43, wherein the phase delayer is selected from a group consisting of: a 90-degree phase delay circuit, and a 270-degree phase delay circuit.

45. The ultra-wideband receiver of claim 43, wherein the phase delayer imparts a delay to a rising edge of the incoming signal.

46. The ultra-wideband receiver of claim 45, wherein the delay shapes the incoming signal to approximately a one bit time duration.

47. The ultra-wideband receiver of claim 29, wherein the output signal generator comprises:

a second multiplier that multiplies the delayed phase signal and the incoming signal to produce a second output signal.

48. The ultra-wideband receiver of claim 29, wherein the output signal generator comprises:

an output signal filter that filters the first output signal and the second output signal.

49. The ultra-wideband receiver of claim 29, wherein the difference signal generator comprises:

a third multiplier that multiplies a first quantized signal with the first output signal.

50. The ultra-wideband receiver of claim 29, wherein the difference signal generator comprises:

a fourth multiplier that multiplies a second quantized signal with the second output signal.

51. The ultra-wideband receiver of claim 29, wherein the difference signal generator comprises:

a difference calculator that calculates an algebraic difference between the first quantized signal and the second quantized signal.

52. The ultra-wideband receiver of claim 29, wherein the difference signal generator comprises:

a difference signal filter that filters the difference signal.

53. The ultra-wideband receiver of claim 29, wherein the quantizer uses a multi-level quantizer.

54. The ultra-wideband receiver of claim 53, wherein the multi-level quantizer is selected from a group consisting of: a μ -law quantizer, a 4 level quantizer, a 8 level quantizer, and a 16 level quantizer.

55. The ultra-wideband receiver of claim 29, wherein each of the plurality of ultra-wideband pulses has a duration from about 10 picoseconds to about 1 millisecond.

56. The ultra-wideband receiver of claim 29, wherein each of the plurality of ultra-wideband pulses has at least one of a phase and an amplitude that conveys data.

57. A system of demodulating ultra-wideband communications comprising:

- means for receiving an incoming signal, wherein the incoming signal comprises a plurality of ultra-wideband pulses;
- means for approximating the incoming signal;
- means for generating a local signal;
- means for generating a first output signal and a second output signal;
- means for quantizing the first output signal and the second output signal to produce a first quantized signal and a second quantized signal;
- means for generating a difference signal for the first quantized signal and the second quantized signal; and
- means for providing an error signal based on the difference signal.